OGC-Sensor Observation Service for a Standardized Access to Raster Time Series Data

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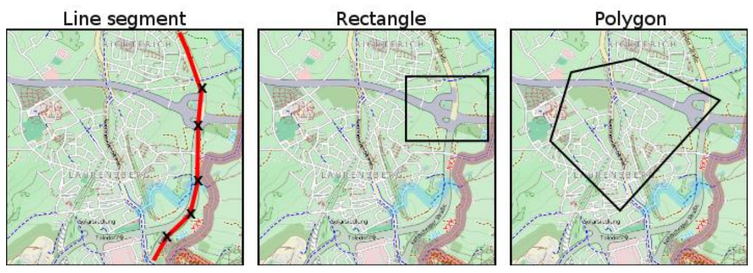
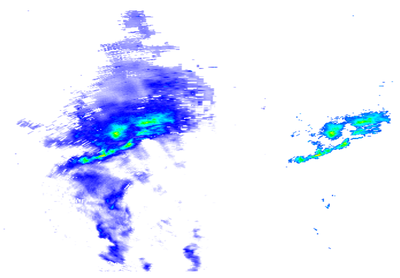
In-Situ measurement stations for observing physical phenomenons (e.g. temperature, soil moisture, etc.) always related to a single geographic point. In contrast, remote sensing stations deliver area differentiated data, related to a certain geographic area. A new approach to manage raster time series data supports the OGC sensor observation service (SOS) specification. It comprises methods for a standardized access to all kinds of time series data with spatial relation to the earth. The advantage of using a SOS instead of e.g. a WCS-EO is the inherence of the temporal relation of each dataset, since a SOS is particularly designed for managing time series. A SOS supports to apply thematic filters to extract thematic attributes of raster data sets. We describe the conception and implementation of an OGC compliant SOS for a standardized access to raster time series data, which allows to select raster data sets using temporal, spatial and thematic filters and to deliver it in a standardized way.

Sensor Observation Service

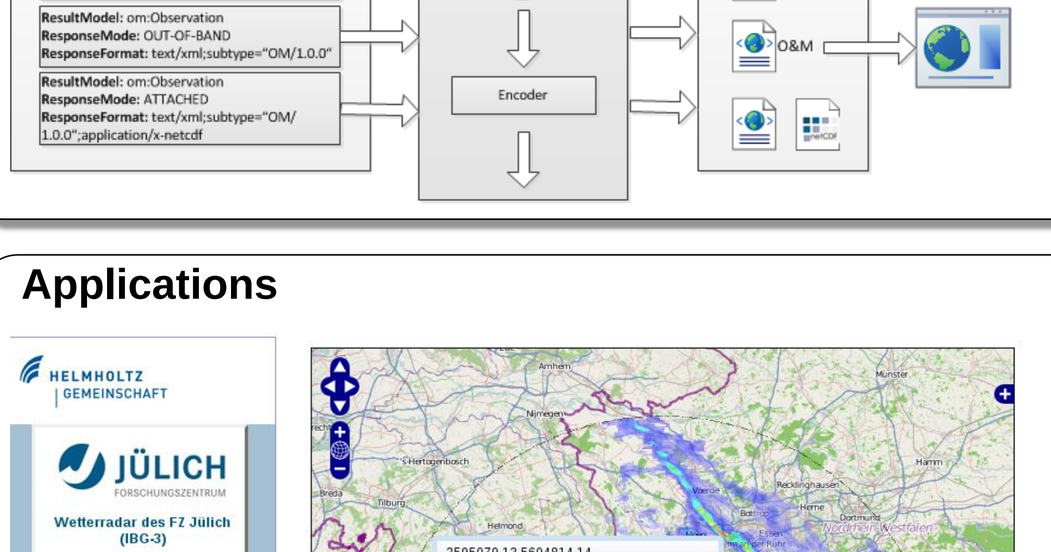
```
1  <GetObservation>
2     <offering>Reflectivity</offering>
3        <eventTime>
4           <o:TM_During>
5              <o:PropertyName>om:samplingTime</o:PropertyName>
6              <gml:TimePeriod>
7                 <gml:beginPosition>2012-01-07T10:28:54</gml:endPosition>
8              </gml:TimePeriod>
9           </o:TM_During>
10       </eventTime>
11    <procedure>WRadar</procedure>
12    <observedProperty>Reflectivity</observedProperty>
13    <featureOfInterest>
14        <o:Intersects>
15           <o:PropertyName>urn:ogc:data:location</o:PropertyName>
16           <gml:Point srsName="EPSG::31466">
17              <gml:pos>5657550.5 2606247.0</gml:pos>
18           </gml:Point>
19        </o:Intersects>
34     </featureOfInterest>
35      <om:result>
36         <o:PropertyIsGreaterThan>
37            <o:PropertyName>Reflectivity</o:PropertyName>
38            <o:Literal>36</o:Literal>
39         </o:PropertyIsGreaterThan>
40       <om:result>
41       <responseFormat>text/xml;subtype="OM/1.0.0" </responseFormat>
42       <resultModel>om:TimeSeriesObservation</resultModel>
43      <responseMode>Inline</responseMode>
50</GetObservation>
```

The OGC SOS specification comprises eleven operations to access observation data, but only the operations GetCapabilities, DescribeSensor and GetObservation are mandatory. The GetCapabilities operation yields general information about the service .The DescribeSensor Operation yields a description of a sensor encoded by the SensorML language. Finally, data can be retrieved by means of the GetObservation operation. The XML fragment in the Example on the right displays an example of a Get-Observation request with all available parameters.
The parameters for temporal, spatial and thematic filters (eventTime Line 3-17, featureOfInterest Line 22-34 und result Line 35-42) are optional. The figure below shows some examples of spatial and thematic filters that are supported by the SOS specification.



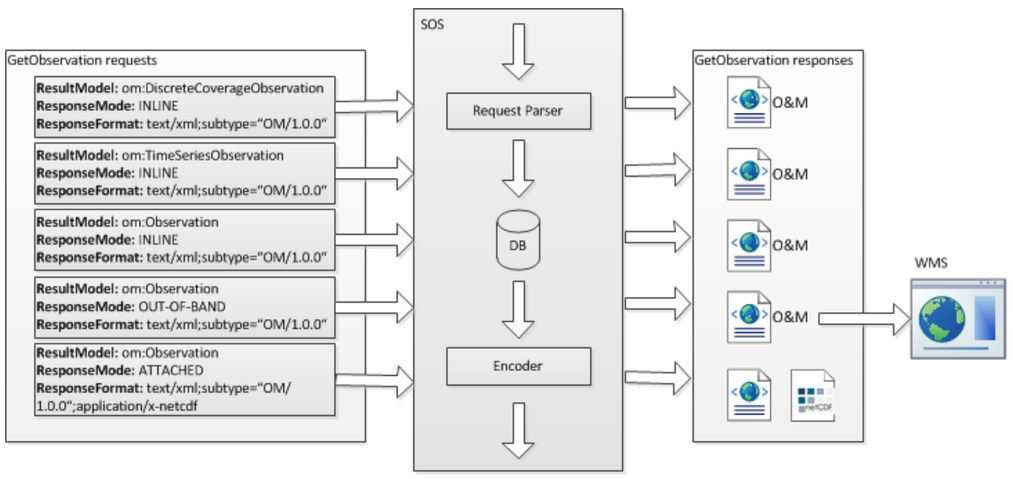


Data Model For Raster Time Series Data



The raster data are stored in a relational database management system (RDBMS), whereas PostgreSQL with the PostGIS extension for spatial data are used. A data model was developed, which supports to store all raster data in one single data table, because of a huge amount of records a raster time series can have. We store each raster data record as a binary large object (BLOB). A BLOB is a database type for large, not nearer specified binary objects. Because there is no additional information about the stored object in a BLOB, the amount of space is minimized on the field of table layer. For an efficient way to extract data under consideration of given filters from the BLOB some algorithms were implemented.

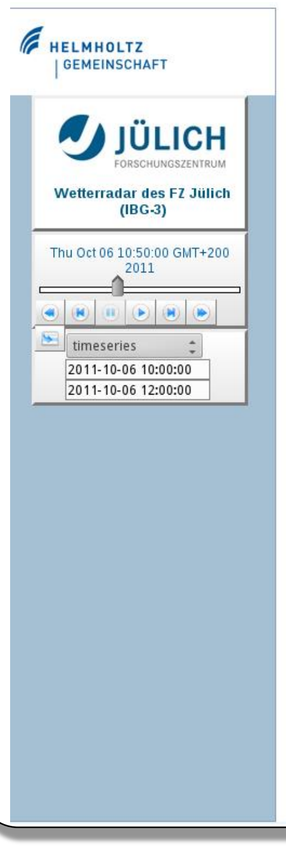
Result Models And Formats

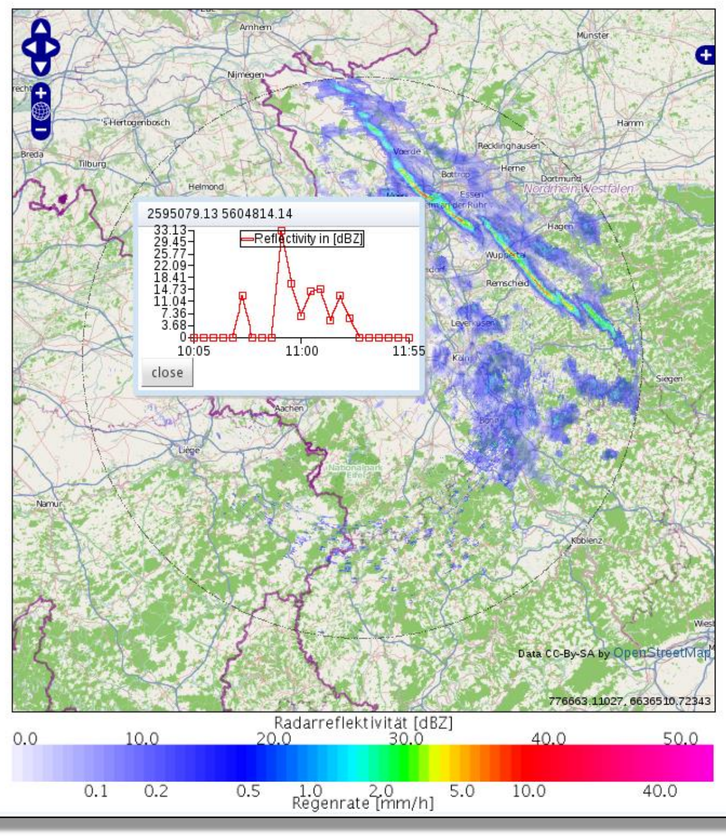


Some different O&M models to deliver data are allowed by the SOS specification, which are significant distinguishable by its accuracy and expressivity.

- Three O&M models are used to return filtered data encoded directly within the resulting document.
- By a combination of SOS and WMS a system was accomplished, that provides a fast access to raster records of a time series for visualizing the data in time crucial web applications.
- Finally, the SOS specification allows to deliver data in an arbitrary format as an additional attachment. In this case the attachment has to be referenced by the response O&M document. Thereby the O&M document and also the data will be transfered within a multipart HTTP body. We encode the raster data in the scientific well known NetCDF file format.

Applications





A web application gathering weather radar data in an interoperable way from the SOS for a fast visual (quality) inspection was implemented. (left)
Also a system was realized, which retrieve filtered weather radar data from the SOS in a standard compliant way to detect heavy precipitation events and alert registered users about this.(above)